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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/026,537	12/27/2001	Ihl Hyun Cho	P 282974 HD-1077/US	9451

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EXAMINER
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RAO, SHRINIVAS H

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 06/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No.		Applicant(s)	
	10/026,537		CHO, IHL HYUN	
	Examiner		Art Unit	
	Steven H. Rao		2814	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**  
**Period for Reply**

**A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.**

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 13 March 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 9-17 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 9 to 17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All   b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                  | 5) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)         | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Priority***

Receipt is acknowledged of paper submitted under 35 U.S.C. 132 and 37 CFR 1.114, requesting a RCE based on U.S. Serial No. 10/206,537 filed on December 27, 2001 which papers have been placed of record in the file.

### ***Request for Continued Prosecution Application***

The request filed on February 05, 2003 for a Request for Continued Prosecution Application (RCE) under 37 CFR 1.114 based on parent Application No. 10/026,537 is acceptable and a RCE has been established. An action on the RCE follows.

### ***Preliminary Amendment Status***

Acknowledgment is made of entry of amendment filed on Feb. 05, 2003 has been entered on March 13, 2003 after entry of the RCE.

Therefore claims 9 as amended by the amendment and claims 10-19 as previously recited are currently pending in the Application.

Claims 1 to 8 have been cancelled by the amendment.

### ***Claim Rejections - 35 USC § 103***

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The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 9, 11 and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fang et al. (U.S. Patent No. 5,858,844, herein after Fang) in view of Iijima et al. (U.S. Patent NO. 5,903,053, herein after Iijima).

With respect to claim 9, Fang describes a method of fabricating a semiconductor device including the steps of: preparing a semiconductor substrate (Fang Fig. 1 A # 14, col. 3 line 15), forming a silicon oxide layer on the semiconductor substrate (Fang fig. 1 A #12, col. 3 line 43-44), forming a conductive layer on the silicon oxide layer (Fang, fig. 1A # 10, col. 3 line 44).

Fang does not specifically teach forming a metal oxide layer with a substantially uniform thickness at an interface between the silicon oxide layer and the conductive layer.

However Iijima in figure 9, etc. and col.13 lines 39-67 describes forming a metal oxide layer with a substantially uniform thickness at an interface between the silicon oxide layer and the conductive layer to form a device with low contact resistance between the upper and lower conductive layers thereby proving conductive layers that do to.

Therefore it would have been obvious to one of ordinary skill in the art at the of the invention to include Iijima's step of forming in a metal oxide layer with a substantially uniform thickness at an interface between the silicon oxide layer and the conductive layer in Fang's method to form a device with low contact resistance between the upper and lower conductive layers thereby proving conductive layers that do not deteriorate the characteristics of the semiconductor device they are incorporated in to.

With respect to claim 11, wherein the conductive layer is a metal layer or a metal nitride layer. (col. 1 lines 25-30).

With respect to claim 18, wherein the step of forming the metal oxide layer comprises of forming the metal oxide with oxygen atoms from the silicon oxide layer (Fang col. 3 lines 18-30).

With respect to claim 19, wherein the silicon oxide layer is a gate insulator and the conductive layer is a gate electrode (Fang col. 3 line 14).

For response to Applicants' arguments see Response to arguments section below.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

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Patentability shall not be negated by the manner in which the invention was made.

Claims 10, 12-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fang et al. (U.S. Patent No. 5,858,844, herein after Fang) as applied to claim 1 above, and further in view of Microchip Fabrication Text book. (herein after Van Zant) as previously applied and further in view of Iijima newly applied (as applied to independent claim 9 above).

With respect to claim 10, wherein the silicon oxide layer has a thickness of 10-100 Å<sup>0</sup> Fang teaches a silicon oxide layer without specifying its thickness.

However, Microchip Fabrication, a textbook by Peter Van Zant (McGraw Hill, fourth edition) pages 511-514 in page 513 describes gate oxide thickness in the range of 100-300 Å<sup>0</sup> to control the threshold voltage.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to form a silicon oxide layer having a thickness of 10-100 Å<sup>0</sup> because it was previously done in the overlapping range of 100-300 Å<sup>0</sup> to form a device with the desired threshold voltage.

With respect to claims 12 and 13, wherein the metal layer comprises of at least one metal selected from a group consisting of Tungsten (W), tantalum (Ta), Titanium (Ti) and Aluminum (Al). (Van Zant page 403 the motivation to combine Van Zant and Fang stated above) for nitride (see claim 11 above).

With respect to claim 14, wherein the conductive layer is 100-2000 Å<sup>0</sup> (Van Zant page 513, gate thickness 60-90 angstroms).

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Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to form a silicon oxide layer having a thickness of 10-100 Å<sup>0</sup> because it was previously done in the overlapping range of 160-90 Å<sup>0</sup> to form a device with speed and other characteristics.

With respect to claim 15, wherein the step of forming the interface includes a thermal treatment at a temperature of 500-100 degrees under inert gas ambient. ( Fang claim 1 step 3 850-900 degrees).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention because includes a thermal treatment at a temperature of 500-100 degrees under inert gas ambient. it was previously done in the overlapping range of 850-900 ° to form a device with highest saturation threshold voltage (Fang col. 4 lines 15-20).

With respect to claim 16, wherein the inert gas is selected from Nitrogen, Argon and Helium ( Van Zant page 413 use of Argon to maintain film composition).

With respect to claim 17, wherein the metal oxide layer formed has a dielectric constant of at least 3.9 .( it is an inherent property of metal oxides mentioned namely Tungsten ( W), tantalum ( Ta) , Titanium ( Ti) oxides to have a dielectric constant of 3.9 or more).

For response to Applicants' arguments see Response to arguments section below.

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***Response to Arguments***

Applicant's arguments with respect to claims 9 to 19 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven H. Rao whose telephone number is (703) 3065945. The examiner can normally be reached on 8.00 to 5.00.

The fax phone numbers for the organization where this application or proceeding is assigned are (703) 7463926 for regular communications and (703) 872-9319 for After Final communications.

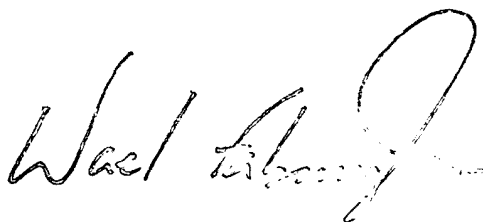
Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 3067722.



Steven H. Rao

Patent Examiner

May 30, 2003.



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